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VEGETATION CHANGE FOLLOWING THE FOREST RESERVE HOMESTEAD ACT OF 1906 IN THE APPLEGATE RIVER WATERSHED, OREGON

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Abstract

Vegetation structure, composition, and community patterns on the landscape of southwest Oregon have changed since Euro-American settlement began in the mid-1800s. Much of this change has been attributed to the transition of land management strategies from those dominated by Native American practices, through the early Euro-American settlement period, and on to the post World War II era of industrial scale timber harvest and fire suppression. Using homestead patent applications and associated land classification maps generated under the Forest Reserve Homestead Act of June 11, 1906, we add to the understanding of historic vegetation conditions and evaluate vegetation change over time for land applied for by homesteaders in the Applegate River watershed of southwest Oregon. These homesteads were predominately located on areas now supporting chaparral, *Pinus* and/or *Quercus* woodlands, mixed conifer forests, pastures, and agricultural land. Our study presents primary source documentation that describes stands dominated by broadleaf trees and shrubs as dense at the time of patent application, contrary to the assumption that such stand structures are an artifact of fire suppression efforts of the last century. Historic vegetation polygons cross tabulated with current classified imagery in GIS indicate that conifer forests and shrublands each retain most of their former extents within their same locations on the landscape. The persistence of shrub stands to current times implies longer-term stability of these communities and indicates that a transition to conifer domination is not evident in all shrublands.

Key Words: Chaparral, grasslands, historic vegetation, oak woodlands, southwest Oregon.

The condition of shrubland and woodland vegetation of the interior valleys and adjacent slopes of southwest Oregon at the turn of the 20th century is thought to be very different from the vegetation we see today. The removal of native peoples and subsequent settlement by Euro-Americans disrupted historic human influences on the land, altered natural processes, and introduced new patterns of human disturbances. Few published studies address the effect these disruptions had on the patterns of vegetation across this landscape (Hosten et al. 2007; Duren et al. 2012). Using homestead patent applications and associated land classification maps generated under the Forest Reserve Homestead Act of June 11, 1906, we add to the understanding of historic vegetation conditions and evaluate vegetation change over time for 36 parcels of land applied for by homesteaders in the Applegate River watershed of southwest Oregon.

Under the Forest Reserve Homestead Act of 1906, settlers were able to submit homestead patent applications for lands within the newly created Forest Reserve (Gates 1913). In the Applegate River watershed this occurred between 1907 and 1918. Applications were submitted to the United States Forest Service, which was required to examine the land in question and document its vegetation cover and agricultural potential. Forest Service rangers and land examiners employed by the U.S. government produced survey reports that classified, described, and mapped the vegetation cover to scale within the surveyed boundaries of the homestead applications (USDA Forest Service 1907). Through the use of this primary source information we were able to describe the composition and structure of the vegetation, and determine the influences homesteaders had on lands applied for under the Forest Reserve Homestead Act in the Applegate River watershed. The vegetation composition maps that accompanied these homestead applications allowed us to perform a direct site comparison to observe coarse vegetation changes over the past century.

The homestead applications that we examined were of lands that are currently administered by the Bureau of Land Management (BLM) or adjacent private lands. It is a widely held assumption by many land managers, natural resource scientists, and members of the public that the characteristic state of low and middle elevation conifer and non-conifer communities of southwest Oregon prior to the onset of effective fire suppression in the last century was that of grasslands, *Quercus* L. savannas, and *Pinus* L./*Quercus* woodlands of open character (Agee 1996; LaLande and Pullen 1999; Arno 2000;

USDA Forest Service 2004). These assumptions are substantiated by historic accounts such as Lindsay Applegate's 1846 description of the valley of the main stem of the Rogue River, of which the Applegate River is a major tributary, as "a great meadow, interspersed with groves of oaks which appear like vast orchards." (Walling 1884, p. 304). While this and other historic accounts from the Euro-American settlement period (Taylor 1921; Giles 1946; Drury 1957) characterize the vegetation as "open", other vegetation descriptions commonly found in primary sources imply a brushy nature to the vegetation of low and middle elevation slopes adjacent to the valleys of southwest Oregon for this same time period. Daniel Giles wrote of traveling near the town of Ruch in 1853 "for about three miles through pine timber and thick underbrush." (Giles 1946, p. 262). Several other sources (Alcorn 1855; Beeson 1858; Taylor 1921; Robbins 1933; Drury 1957; O'Donnell 1991) report similar vegetation structural conditions for around the same time period. Examinations of stand age structures, General Land Office survey notes, historic photos, and other primary source information have validated the variability of historic vegetation density and that closed canopy woodlands were common in the region during the final quarter of the 19th century (Hosten et al. 2007; Duren and Muir 2010; Gilligan and Muir 2011; Hickman and Christy 2011; Duren et al. 2012).

Fire as a disturbance on the landscape had a pervasive and extensive influence on the formation of vegetation patterns of the Applegate River watershed (Whittaker 1960; Detling 1961; Franklin and Dyrness 1988; Agee 1991; Riegel et al. 1992). While natural ignition of fire undoubtedly occurred and played an important ecological role, ethnological records for the Applegate River watershed indicate that Native Americans actively managed parts of the landscape using fire, predominately in valley bottoms and adjacent slopes and around high elevation camps (LaLande 1995; Pullen 1996; LaLande and Pullen 1999). In the nearby Rogue River valley, the Takelma people were reported to have used fire to drive game, facilitate the collection of acorns, seeds, and insects, and to maintain grasslands and open *Quercus* savannas and woodlands (Walling 1884; Sapir 1907). Fire use for similar activities was likely repeated in the Applegate River watershed, as it was throughout the Pacific states (Holmes 1990; Williams 2000; Whitlock and Knox 2002), resulting locally in grasslands and open *Quercus* and/or *Pinus* stand structures. Native American management techniques using fire would have effectively ceased when native peoples were removed from the Applegate River watershed in the 1850s (LaLande 1995). Prospectors in the Rogue River valley and elsewhere set fire to hillsides to remove vegetation and reveal mineral resources (Butler and Mitchell 1916; LaLande 1995). Early cattlemen also used fire to maintain grassy areas, clear shrublands and promote young re-growth to provide additional forage for grazing livestock (Leiberg 1900; LaLande 1995; Alvord 1996), itself a new and ubiquitous influence on the vegetation in the area. Agee (1991) reported a fire frequency of 16 years between 1760 and 1860 and 12 yr from 1850–1920 on a south-facing slope in the Applegate River watershed slightly higher in elevation from the area we examined. The modern era of fire suppression was likely not effective on a landscape scale until after World War II, when an effort of the necessary magnitude was able to be applied to the perceived threat of wildfire. Other anthropogenic disturbances of the last one hundred and fifty years of Euro-American settlement that substantially influenced the patterns of vegetation we see today include timber harvest and attempts at clearing land for agriculture. These activities were frequently mentioned in the homestead applications and survey reports we reviewed. Widespread hydraulic mining also severely altered the development of vegetation along river and stream courses at a local scale.

An analysis of woodland stand age structure conducted in the Applegate River watershed revealed a high rate of *Quercus garryana* Douglas ex Hook. establishment from 1850–1890 with a substantial decline thereafter, and, in a limited number of stands, a significant increase around 1950 in the recruitment of *Pseudotsuga menziesii* (Mirb.) Franco (Gilligan and Muir 2011). Vegetation changes in non-conifer communities of the Applegate River watershed under conditions of fire exclusion include the loss of grasslands and open *Quercus* communities and transition to shrublands and/or closed canopy woodlands; the gradual accumulation of long-lived hardwood trees (e.g., *Quercus garryana*) in chaparral; and the accumulation of conifers in more mesic stands dominated by hardwoods (Hosten et al. 2006). The rate at which this transition to closed canopy conditions occurs is related to edaphic and other environmental conditions (Pfaff 2007).

Our objectives were to (1) evaluate the influence of homesteaders on the vegetation of middle to low elevation slopes of the Applegate River watershed through the period of the Forest Reserve Homestead Act, (2) describe the historic vegetation at the time of mapping, and (3) observe vegetation change between the time of mapping and the present. To meet these objectives we collected historical accounts from homestead applications and land classification surveys and imported into a GIS (Geographic Information System) (ESRI 2005) the spatial

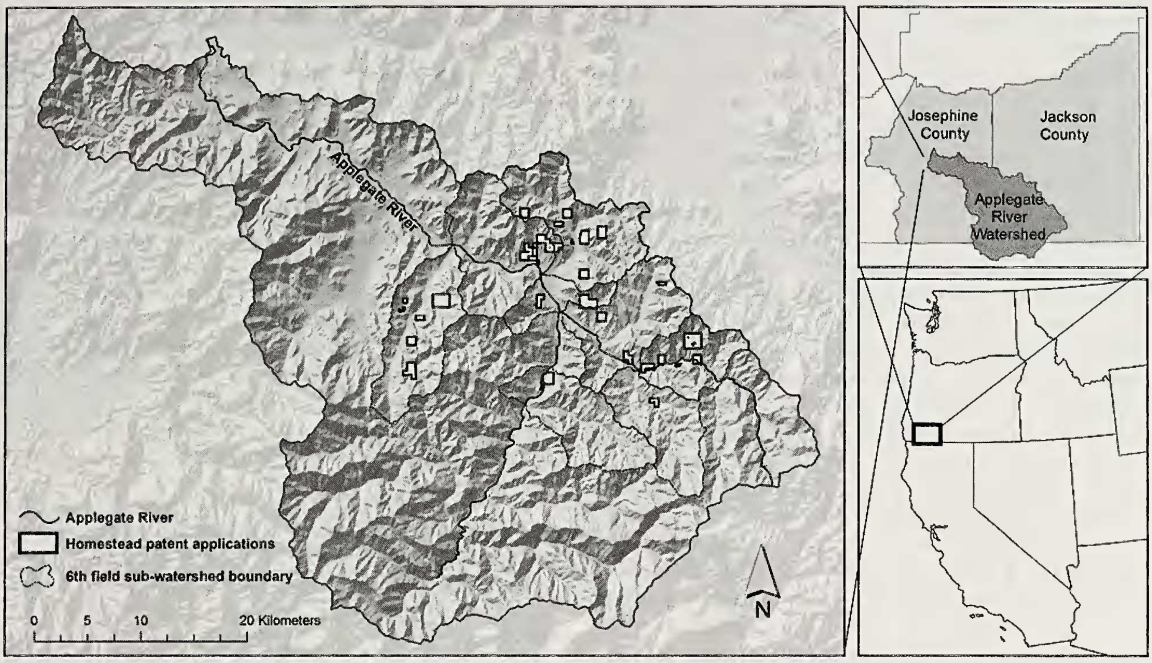

FIG. 1. The Applegate River watershed and the study area as shown by the extent of the homestead patent applications. 6th field sub-watersheds that contain homestead parcels are outlined.

information provided in the historic vegetation composition maps and compared it with current classified imagery.

METHODS

Study Area

The Applegate River watershed, located in southeast Jackson County and southwest Josephine County, Oregon (Fig. 1), is an interior valley located between the Cascade Range and the Siskiyou Mountains. The valley bottom along the main stem of the Applegate River and larger tributaries is broad, flat, and composed of alluvial soils. The foothills and mountains are characterized by steep slopes, deeply dissected drainages, and somewhat level ridgetops. The climate in the region is generally described as Mediterranean due to mild wet winters and hot dry summers. Conifer forests predominate at middle to high elevations and north facing slopes and in moist drainages at lower elevations. Meadows, chaparral, *Quercus* savannas, and *Quercus* and *Quercus*/*Pinus* woodlands occur at low to middle elevations on lower slopes, south facing aspects, valleys, and foothills; areas heavily influenced by serpentine geology; and on steep, south facing aspects with shallow, gravelly clay loam soils where droughty conditions limit the accumulation of conifers. At the tops of some mountains and ridges are prairies ringed by scattered *Quercus* clumps or bands of *Quercus* woodlands (Hosten et al. 2007).

These 36 parcels of land applied for under the Forest Reserve Homestead Act were selected as the extent of the study area because they represented the majority of the most complete homestead applications and survey reports available for review, and were the most concentrated spatial grouping of homesteads occurring within a large and discrete watershed that can be uniformly described. The Applegate River watershed is often treated as a discrete geographic unit in historical documents as well as by present day land managers and researchers, and therefore offers ready comparison with other studies and descriptive efforts of historic vegetation. Homestead parcels cover 2516 ha located within just eight of the 29 6th field sub-watershed units in the Applegate River watershed. This is roughly 1% of the total area of the Applegate River watershed and 3% of the 6th field sub-watersheds examined (Fig. 1).

Historical Accounts

To describe the historic vegetation at the time of mapping and evaluate the influence of homesteaders on the vegetation, we searched Forest Reserve Homestead Act applications within the Applegate River watershed that contained vegetation composition maps (Fig. 1). These were archived at the Bureau of Land Management

Medford District Office. Vegetation descriptions and ancillary information about Euro-American influence on vegetation were summarized. To compare historic and current vegetation, land classification maps were scanned and converted to digital images, which were imported and georeferenced in GIS (Fig. 2). For each map, polygons were drawn around the cover types delineated by the Forest Service surveyors. Polygons representing similar cover types based on surveyors' descriptions were grouped together and given consistent labels across all maps. Historic vegetation designations were assigned vegetation class names that coincided with the classes in the WODIP (Western Oregon Digital Imagery Project) classified imagery (Nighbert et al. 2000) (Table 1). Homestead application maps were compared with a topographic site index to determine their slope position (Jenness 2006).

Data were examined at two scales: the entire Applegate River watershed and 6th field subwatershed hydrologic units. To compare historic to current vegetation cover, the degree to which vegetation classes had changed between the time of the original mapping and recent time was evaluated. Two independent evaluations of vegetation change were conducted that compare historic vegetation maps with current information: a cross tabulation by area and a presence/absence assessment.

Cross tabulation by area. Historic vegetation maps were compared directly to recent (1993) WODIP classified imagery with similar vegetation classifications in GIS. In order to compare the historic vegetation polygons created in GIS with the WODIP data, the polygons were converted to rasters with 30 m^2 grids. Cross tabulation by area was completed at both the Applegate River watershed and 6th field subwatershed scales using the Tabulate Area function in Arc Toolbox (ESRI 2005). This calculated the amount of area of the historic vegetation classes that intercepted with present vegetation classes in WODIP. Results were displayed as a percent of the total area of a historic vegetation class that is now occupied by a current vegetation class based on 30 m^2 grids.

WODIP vegetation classes that correspond to historic vegetation classes are displayed in Table 1. The Non-forest Vegetation class in WODIP is defined as encompassing all other native vegetation that is not forest. Hardwood Woodland, Shrubland, and Grassland were analyzed as separate historic vegetation classes, though together they are equivalent to the Non-forest Vegetation class in WODIP. Visual observation of WODIP overlaid with 2005 orthophotos showed that the Non-forest Vegetation class encompassed shrublands, hardwood woodlands, and grasslands as seen in the orthophotos. However, the few areas visually interpreted to be current grasslands within the extent of historic maps were grassy balds that did not occupy the same topographic position as grasslands depicted in the historic maps. Much of the area within the extent of historic maps classed as Non-forest Vegetation in WODIP was, through visual examination, determined to be shrublands or hardwood woodlands. The interpretation of our results reflects this understanding of the WODIP information. Imperfect spatial alignment of historic maps when brought into GIS, the coarseness of the original vegetation mapping by Forest Service surveyors as well as the coarseness and misidentifying of grids in WODIP provide us with historic and current maps that are approximations of the extent of vegetation classes.

Presence/absence. Two assessments of the presence or absence of vegetation classes were completed by visual comparison with digital orthophoto quadrangles (obtained under multi-agency contract with USGS, most images from 2005) to determine whether historic vegetation classes still occurred within the extent of the homestead parcel and within the extent of the historic vegetation polygon. First, for each vegetation class present within the boundaries of the homestead parcel on the historic map, we noted whether that same vegetation class was present or absent within those same boundaries in the 2005 orthophoto. Second, we noted whether current vegetation classes were present or absent within the extent of each historic vegetation polygon. This overcame some of the limitations in information classes provided in WODIP, particularly in regard to grasslands being grouped with shrublands and hardwood woodlands in the Non-Forest Vegetation class. The current vegetation class "Conifer Woodland" was added for this analysis and is comparable to the *Pinus ponderosa* Woodland vegetation class used in historic classifications.

Results

The majority of the area of the 36 Forest Reserve Homestead Act homestead parcels examined was located on middle (62%) and lower (20%) slopes (Fig. 3). Out of the total area of 2516 ha examined, the historic vegetation class that was described by surveyors to cover the greatest extent was Shrubland at 1250 ha followed by Conifer Forest at 684 ha (Table 1).

Historic Accounts

Vegetation descriptions of lands sought under the Forest Reserve Homestead Act use a preponderance of descriptors indicating dense nonconifer vegetation (Table 2). Of the 36 homestead

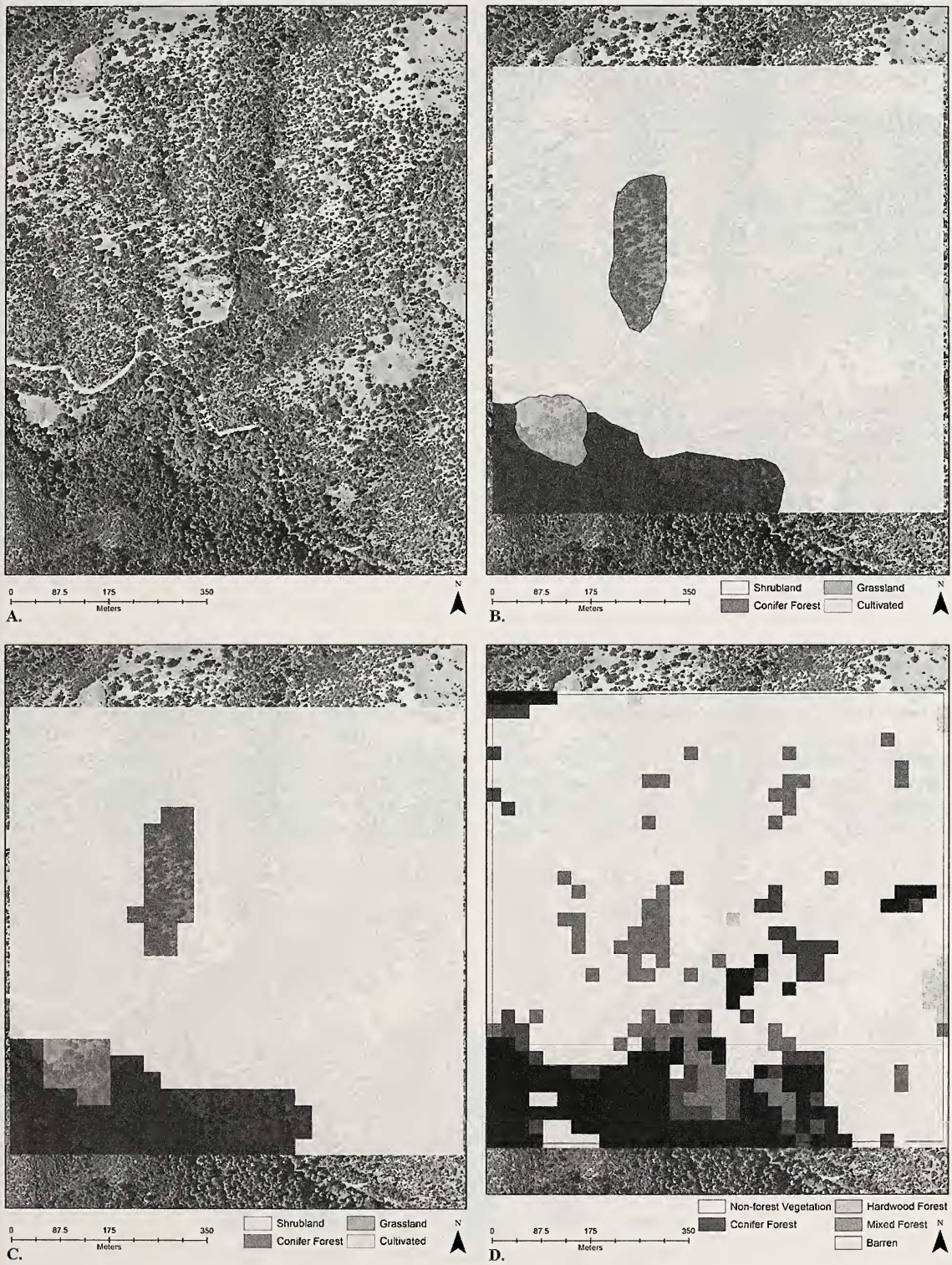

FIG. 2. An example of historic vegetation survey maps and current digital imagery overlain on a 2005 orthophoto at the same location. A. Current orthophoto in the Applegate River watershed near the Little Applegate River. B. Historic polygons of vegetation classes that were delineated by Forest Service surveyors. C. Historic polygons converted to raster data. D. WODIP digital imagery.

TABLE 1. VEGETATION CLASSES AND THEIR TOTAL EXTENT WITHIN THE STUDY AREA. Historic vegetation designations were grouped and assigned vegetation class names that coincided with the classes in WODIP.

Historic vegetation classes	Area (ha)	Historic vegetation classes comparable to WODIP vegetation classes	WODIP vegetation classes
Barren	16.8	Barren	Barren
Burn	5.3	Burned	N/A
Conifer Forest	684.4	Conifer Forest	Conifer Forest
Conifer Hardwood Forest	26.2	Mixed Woodland/Forest	Mixed Forest
Ponderosa Pine Woodland	38.2	Mixed Woodland/Forest	Mixed Forest
Cultivated	231.4	Cultivated	Urban-agriculture
Grassland	47.7	Grassland	Barren/Non-forest Vegetation
Hardwood Woodland	128.4	Hardwood Woodland	Hardwood Forest/Non-forest Vegetation
Shrubland	1250.4	Shrubland	Non-forest Vegetation
Unidentified	87.2	Unidentified	N/A
Study Area	2516		

applications, 72% mention the presence of brush or chaparral, with frequent references to the high density of the vegetation. Most homestead patent applications were located away from the main stem of the Applegate and Little Applegate Rivers, often on toe-slopes leading to higher elevations and in small drainages among foothills. This places the plant communities described predominantly on lower to middle elevation slopes. Comparable vegetation types were described at similar locations in the vicinity of the Applegate River watershed in Natural Resource Conservation Service soil surveys for Jackson County (Soil Conservation Service 1993).

In addition to clearing and cultivating, homesteaders affected these parcels and adjacent land through grazing livestock. Of all 17 claims that were reported to have livestock, 16 had at least two domestic ungulates grazing on them. Of these 16 claims, nine had more than eight animals on the property, mostly a mix of horses, cattle, hogs, sheep, and goats, and five of those nine claimants had herds of 20 animals or more. All but one of these five claimants grazed livestock on the claim as well as on the Forest Reserve under permit with the Forest Service.

Cross Tabulation by Area

Change in vegetation composition class area was calculated at two watershed resolutions, the Applegate River watershed and the 6th field subwatershed level. At the Applegate River watershed resolution, 61% of historic Shrubland remained in the Non-forest Vegetation class (Table 3). Much (33%) of the remaining historic Shrubland was classified by WODIP as a forest class, most (20%) of which is Conifer Forest.

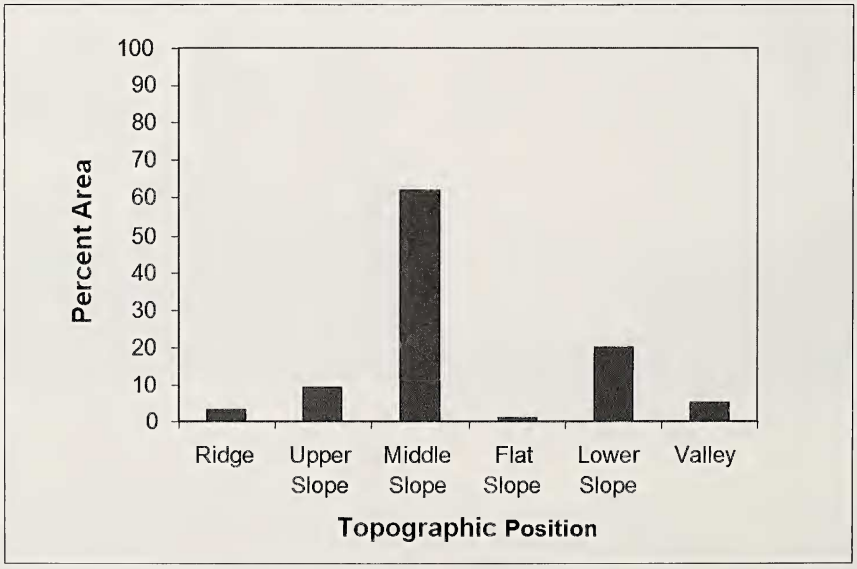

FIG. 3. Homestead patent applications cross-tabulated by area with a topographic position index. Results displayed as a percent of total homestead area that occurred in topographic position categories.

Table 2. Keyword Vegetation Descriptions from Forest Reserve Homestead Act Homestead Patent Applications. Underlined keywords indicate sites with shrubs as a component of the vegetation. Application descriptions are separated by a period.

Township and range	Keyword vegetation descriptions
T. 38S, R. 3W, Section 8	Heavy timber; scattering timber; heavy black oak and madrone; tillable land with scattering timber.
T. 38S, R. 3W, Section 10	Under cultivation; cleared but not under cultivation; 2–15 yellow pine and Douglas fir 8″–24″ DOB and yellow pine and Douglas fir 12″ to 20″ tall 20 to 300 per ac - 1000 B.M.; manzanita, madrone and oak on most of areas dense. 1500 ft per ac yellow pine and Douglas fir; 2000 ft per ac yellow pine and Douglas fir; yellow pine reproduction; chaparral and manzanita.
T. 38S, R. 3W, Section 13	Cleared; chaparral; conifer forest.
T. 38S, R. 3W Section 14	Young growth fir 4 to 10 ft high; dense brush consisting principally of chaparral, grub oaks, and manzanita. Oregon oak, madrone, manzanita, scattering pine and fir.
T. 38S, R. 3W, Section 16	Cultivated; cleared; brush. Dense growth reproduction yellow pine; dense growth of manzanita and chaparral.
T. 38S, R. 3W, Section 20	Chaparral and manzanita brush; open; yellow pine and Douglas fir reproduction; scattered yellow pine 1200 ft per ac; barren rocky. Scattering white oak; good reproduction of yellow pine and Douglas fir; scattered yellow pine 10,000 ft B.M.; dense growth of oak grubs, manzanita, and chaparral. Chaparral and manzanita brush; Burn - 1915 - not restocking; scattering oaks grubs; scattering timber and reproduction (yellow pine and Douglas fir). Cultivated; chaparral; cleared.
T. 38S, R. 3W, Section 22	Chaparral and manzanita; open and scattering brush; under cultivation; yellow pine and Douglas fir reproduction. Brush; grass; timber-less than 2000 BF.
T. 38S, R. 2W, Section 26	Cleared and cultivated; fir; yellow pine, madrone. Farm; open land; underbrush; brushy side hill; high brushy ridge; Timber.
T. 38S, R. 2W, Section 34	Brush; grass; timber-less than 2000 BF.
T. 39S, R. 2W, Section 13	Chaparral and scrub oak; maple, white oak, black oak, birch, ash; under cultivation; grassland.
T. 39S, R. 2W, Section 20	Grassland - glade; chaparral - scattered pines.
T. 39S, R. 2W, Section 22	Brush; timber - less than 2000 B.F.; cultivated.
T. 39S, R. 2W, Section 24	Brush; grassland; old cuttings; timber; cultivated.
T. 39S, R. 3W, Section 1	Chaparral, scrub oak, manzanita; cultivated; grasslands - parks.
T. 39S, R. 3W, Section 4	One ac slashed; 10 ac cleared; One ac in orchard; 120 ac of timber.
T. 39S, R. 3W, Section 12	Dense chaparral; brush; open.
T. 39S, R. 3W, Section 14	Brush; open.
T. 39S, R. 3W, Section 28	Alfalfa fields; rocky gravel bars and rock bluffs; steep rocky ridges and mostly covered with young growth.
T. 39S, R. 4W, Section 6	Manzanita and chaparral; brush very dense also some white oak grubs; cultivated.
T. 39S, R.4W, Section 8	Timbered side hill 20,000 ft B.M. per ac; small underbrush; woodland; cultivated, garden ground.
T. 39S, R.4W, Section 14	Brush; cultivated; poles, woodland; grassland; water.
T. 39S, R.4W, Section 18	30 ac 26,500 ft B.M. to ac; 50% yellow pine 50% red fir; cultivated; brushy; poles, cordwood; grassland.
T. 39S, R.4W, Section 30	Brush; 60% fir, 40% yellow pine; clearing. Chaparral and manzanita 60% fir 40% yellow pine.
T. 40S, R.2W, Section 4	Chaparral or brush; cultivated; slashing; 250,000 ft B.M. 65% yellow pine 35% fir. 200,000 B.M. 60% fir, 30% pine, 10% cedar; cultivated.

Conifer Forest retained much of its historic area, with 54% still classed as Conifer Forest. While 13% of the historic Conifer Forest area was classed as Mixed Forest in WODIP, much of the remainder (24%) was classed as Non-forest Vegetation.

The 6th field sub-watershed analysis examined vegetation change at a more local scale (Table 4). Most sub-watersheds exhibited the same pattern as the Applegate River watershed analysis of only modest change in the amount of area within homestead parcels historically occupied by Conifer Forest and Shrubland. However, two sub-watersheds (Forest Creek and Thompson Creek) displayed an increase in current Conifer Forest area within the area historically occupied by Shrubland. Another two sub-watersheds (Humbug Creek and Middle Little Applegate) displayed an increase in current Non-forest Vegetation area within the area historically occupied by Conifer Forest. These changes in area over time were a transition towards the most extensive vegetation

TABLE 3. CROSS TABULATION RESULTS FOR THE APPLEGATE RIVER WATERSHED. Results are displayed as a percent of the total extent of historic vegetation classes that overlap WODIP classified vegetation classes (e.g., 24% of the extent of historic Conifer Forest is classed as Non-forest Vegetation in WODIP).

Historic vegetation classes	WODIP vegetation classes					
	Barren	Conifer Forest	Hardwood Forest	Mixed Forest	Urban-agriculture	Non-forest Vegetation
Barren	3	3	7	3	2	75
Burned	0	17	12	29	0	42
Conifer Forest	1	54	5	13	4	24
Mixed Woodland/Forest	1	29	5	28	2	36
Cultivated	1	18	3	5	45	26
Grassland	0	6	4	4	38	46
Hardwood Woodland	1	45	2	13	9	30
Shrubland	1	20	5	8	5	61

class currently within the sub-watersheds as depicted by WODIP.

Throughout the entire study area, 45% of historic Cultivated area remained cleared (Table 3). While this represents the greatest percentage of any vegetation class that currently occupies historically cultivated land, a larger amount (53%) of this area is now occupied by native vegetation types represented by all the remaining vegetation classes in WODIP. Non-forest Vegetation was the largest component of these combined vegetation classes at 26%, followed by Conifer Forest at 18%.

Most native grasslands mapped by Forest Service surveyors were located on lower slopes, in valley bottoms and at the confluence of streams at low to middle elevations. Much of the extent of this historic vegetation class was now occupied by Non-forest Vegetation (46%) or Urban-agriculture (38%) (Table 3). Within the extent of historic polygons classed as Hardwood Woodland, 30% was classified in WODIP as Non-Forest Vegetation and two percent classified as Hardwood Forest. The majority of historic Hardwood Woodland area (45%) was classified in WODIP as Conifer Forest and 13% was classed as Mixed Forest.

Presence/Absence Assessment

The first presence/absence assessment compared 36 individual homestead maps with 2005 orthophotos. These comparisons showed that 86% of homesteads had retained historic Conifer Forest, 68% had retained Shrubland, and 90% had retained historic Cultivated area (Table 5). However, nine out of 12 homestead parcels with historic Grassland no longer contained grasslands and 72% of homesteads contained Hardwood Woodland where it was not reported historically (Table 5).

TABLE 4. CROSS TABULATION RESULTS FOR SUB-WATERSHEDS. Numbers in bold show changes in historic to current vegetation cover. Results are displayed as a percent of the total extent of historic vegetation classes that overlap WODIP classified vegetation classes.

Sub-watershed	Historic vegetation classes	WODIP vegetation classes					
		Barren	Conifer Forest	Hardwood Forest	Mixed Forest	Urban-agriculture	Non-forest Vegetation
Forest Creek	Conifer Forest	0	55	5	15	0	24
	Mixed Woodland/Forest	1	34	3	32	0	29
	Cultivated	1	3	9	10	47	31
	Shrubland	0	**51**	2	7	3	37
Thompson Creek	Conifer Forest	0	67	4	10	4	16
	Cultivated	1	18	2	8	64	8
	Shrubland	1	**33**	5	**12**	7	43
Humbug Creek	**Conifer Forest**	1	25	8	22	1	**42**
	Mixed Woodland/Forest	1	11	4	18	6	61
	Cultivated	2	1	14	5	54	24
	Shrubland	0	15	7	15	6	57
Middle Little Applegate	**Conifer Forest**	2	35	3	4	3	**52**
	Cultivated	2	11	2	3	41	41
	Shrubland	2	11	7	5	2	73

Table 5. The Number of Homestead Applications, Out of 36, in Which A Particular Vegetation Class was Encountered.

Vegetation class	Historic map only	Historic map and 2005 orthophoto	2005 orthophoto only	Neither
Barren	2	0	0	34
Burn	1	0	0	35
Conifer Forest	3	19	12	2
Conifer Hardwood Forest	1	1	25	9
Pinus ponderosa Woodland	2	1	2	31
Cultivated	2	20	5	9
Grassland	9	3	2	22
Hardwood Woodland	1	6	21	8
Shrubland	9	19	6	2

The second presence/absence assessment examined current vegetation classes within the extent of historic vegetation polygons (Table 6). The comparisons showed that Conifer Forest, Shrubland, and Cultivated vegetation classes have predominantly retained their occurrence within the boundaries of their historic mapped extents. However, the presence of different vegetation classes within these historic vegetation polygons reflected some change in vegetation cover. Among historic Grassland polygons, 85% no longer contained grasslands, and Conifer Forest commonly occurred within historic Hardwood Woodland polygons (Table 6).

Discussion

The homestead patent application process as applied to the Applegate River watershed favored certain topographic locations on the landscape. Homestead application maps compared with a topographic site index showed that most of the area of homestead parcels was located on middle and lower slopes. Only five percent of the total mapped extent of homesteads was located in a valley, reflecting the fact that much of the valley bottom land in the Applegate River watershed had already been claimed and occupied by earlier settlers by the time claims were being made through the Forest Reserve Homestead Act. The presence of these earlier settlers most likely had an effect on the vegetation of the lands examined in this study in a number of ways, including the grazing of free ranging livestock, incidental burning from fires started lower in the watershed, isolated logging, and perhaps some placer mining activities (LaLande 1995). In addition to the unavailability of valley bottomland, homesteading rules compelled applicants to avoid sites with considerable stands of timber, though exceptions did occur. The following descriptions of homestead activities and vegetation change are generally restricted to lower and middle elevation slopes that had a low abundance of conifer trees.

Euro-American Disturbance

It was clear through examination of written accounts that the settlers of this time period were not always the first non-indigenous people to affect these parcels. Two claims had abandoned mine shafts and prospect holes on them. Another had a clearing and cabin that predated the claimant. The surveyor noted that the clearing

Table 6. The Number of Historic Polygons of Each Historic Vegetation Class in Which Current Vegetation Classes Occurred. Numbers in bold show vegetation changes.

	Current vegetation classes							
Vegetation class of historic polygons	Conifer Forest	Conifer Hardwood Forest	Conifer Woodland	Cultivated	Grassland	Hardwood Woodland	Shrubland	Total polygons
Barren	1	0	0	1	0	1	2	2
Burn	1	0	0	0	0	1	1	1
Slash	1	0	0	1	0	0	2	3
Conifer Forest	28	20	3	13	0	13	19	45
Conifer Hardwood Forest	3	0	0	0	0	1	0	3
Pinus ponderosa Woodland	1	2	1	1	0	3	0	3
Cultivated	16	8	0	19	4	17	4	31
Grassland	2	8	1	9	**3**	12	5	20
Hardwood Woodland	**8**	4	0	2	2	6	3	9
Shrubland	25	21	6	17	10	34	31	52

was likely kept open by squatters, miners, and settlers that had stayed at the site over the years and speculated that the cabin was built by prospectors, evidenced by all the prospecting holes dug about the place. An old quartz mill was located on another parcel. An open grassy area on one parcel was reported as being used as a public pasture prior to the claimant filing on the property. Timber had been previously high-graded off another claim by local residents to be used for local construction.

The cross tabulation analysis of historic Cultivated land showed that a significant amount of this historic vegetation class has been retained in the Urban-agriculture class. However a slightly larger percent of the area historically classed as Cultivated is now in vegetation classes representing native vegetation types. Areas cleared on sites that remained in public ownership returned to native vegetation. The presence/absence assessments supported the cross tabulation results, which showed that most homesteads with historic Cultivated area and most historic Cultivated polygons currently contained this vegetation class.

Conifer Forest

Forest Service surveyors reported stands of young conifer reproduction on 16 out of 36 claims. Of these claims, five had stands that were described as dense. Surveyors described conifer stands on 11 claims as mature timberland and four of these were described as having a brush understory. No mention was made of the character of the understory for the rest of the mature conifer stands. However, a metes and bounds survey of one parcel recorded three times passing through open pine ridges or slopes (Whitney 1910). One additional stand of young growth conifer was reported to have a scattering of mature *Pseudotsuga menziesii* and *Pinus ponderosa* P. Lawson & C. Lawson. There were seven claims on which vegetation was characterized as brush or chaparral with scattered *Pinus* trees, one claim as brush with scattered *Pinus* and *Pseudotsuga menziesii* trees, another claim as a "thick stand of scrub oak, mixed with a few yellow pines (*Pinus ponderosa*) and yellow fir (likely *Pseudotsuga menziesii*)" (Tungate 1909), and three claims as hardwood woodlands with scattered *Pinus* trees. These results suggest a diversity of conifer structures on the patent application sites including open *Pinus* stands on ridges, regenerating stands with scattered older cohorts, and an association with a dense shrub layer. Several descriptions of shrublands mention a scattering of *Pinus ponderosa*, a structural feature lacking in many current day shrubland plant communities.

The cross tabulation results revealed that forest vegetation remained the dominant vegetation class in both historic Conifer Forest and historic Mixed Woodland/Forest polygons. Conifer Forest remained the dominant vegetation class in historic polygons classed as Conifer Forest. In historic maps with substantial area classed as Shrubland, Conifer Forest was confined to draws, similar to where conifer cover occurs today in the Applegate River watershed on middle to low elevation slopes amid a matrix of shrublands and woodlands. Other homesteads located in areas that were mostly forested 100 yr ago retained the same general cover today. The presence/absence assessments demonstrated that most homesteads with historic Conifer Forest retained this vegetation class and that conifer forests are still present within the extent of most historic Conifer Forest polygons.

Non-Forest Vegetation

Eleven claims had stands of vegetation mapped and characterized as chaparral or brush but did not indicate species. Of these, three were described as dense. Eight claims had stands described as *Quercus* scrub and/or *Arctostaphylos* Adans. chaparral, with two of these labeled dense. Three claims had stands identified as *Quercus* trees or *Quercus* and *Arbutus menziesii* Pursh trees. One additional claim mapped an area described as being covered by dense chaparral and brush with scattered *Quercus* trees. Two claims contained riparian hardwood woodlands, one consisting of *Fraxinus* L. and *Alnus* Mill. trees, the other of *Fraxinus*, *Acer* L., *Betula* L., *Quercus garryana* and *Quercus kelloggii* Newb. trees, and "an occasional wild crabapple" (Whitney 1910).

Non-forest Vegetation area remained the most extensive vegetation class within the extent of historic polygons classed as Shrubland. This is possibly due to these sites possessing the environmental conditions that tend to support non-forest type vegetation and exclude conifer trees and tall, closed canopy conditions. Moreover, the location of these sites on middle to low elevation slopes may have left them susceptible to repeated human caused disturbance, with the frequency of stand replacement disturbance and infrequency of conifer seedling survival limiting conversion to conifer forest. The presence/absence assessments corroborate this, which showed that most homesteads with historic Shrubland retained this vegetation and that shrublands are still present within the extent of many historic Shrubland polygons. This result emphasizes the constancy of many non-conifer communities.

Changes in percent cover from Shrubland to Conifer Forest and Conifer Forest to Non-forest Vegetation represented the most significant

amount of change in area for each of these historic vegetation classes. This may illustrate the dynamic nature of non-conifer communities embedded among conifer communities. The area that had undergone change to another vegetation class could represent seral states in each respective community type, their current condition dependant upon time of last disturbance. Some of the change observed could also be attributed to the coarseness of the original vegetation mapping by Forest Service surveyors and the coarseness and misidentifying of grids in WODIP.

Some of the historic extent of Hardwood Woodland remained classified as Non-forest Vegetation. However, the majority of this extent was currently classified as Conifer Forest and Mixed Forest, representing an increase in conifer trees within these polygons. In the second presence/absence analysis, patches of conifer trees were commonly observed within the extent of historic Hardwood Woodland polygons. Another observation made during the presence/absence analysis may indicate vegetation change because of a prolonged interval without a stand replacement disturbance within historic Shrubland polygons. Many areas historically classed as Shrubland now contain extensive areas of hardwood woodland, the proliferation and increased size of longer-lived hardwoods the likely result of an extended period without a stand replacing fire.

Most grasslands that were mapped by surveyors in the homestead applications were no longer present within their former extents. Much of the extent of these grasslands occurred in drainage bottoms and on adjacent benches and slopes and therefore represented already open and perhaps arable land. These were often the first places homesteaders attempted to cultivate their crops or seed to pasture grasses. There were several examples of cultivated areas embedded within pre-existing grasslands in the homesteads maps we examined. In addition, homesteaders also tended to build their homes near grasslands, further ensuring the influence by homesteaders on these grasslands.

Little mention is made of grasslands in written descriptions save one homestead claim that documents conversion of a grassland to cultivated land over ten years. Three separate claimants filed for this parcel. Forest Service surveyors visited the site on two occasions to evaluate the claim and in between these visits a claimant described the grassland in his application for listing the parcel. In 1911, the first Forest Service surveyor reported "A large natural glade traverses both forties from north to south"(Whitney 1911). A year later a claimant described "Eight or ten acres natural clearing"(Garrett 1912). Survey reports indicate that the first two claimants did not cultivate any part of the claim. By 1921 a third visit recorded that "The claim contains no open grass or meadow land," and that the current claimant had 10 ¼ acres under cultivation (Port 1921). This documented the likely scenario that the grassland described in the initial 1911 survey had been converted to agricultural land by 1921.

The cross tabulation analysis reports a prevalence of the current Urban-agriculture class in areas historically classed as Grassland. The presence/absence assessments revealed that most homesteads with historic grasslands no longer contained them. Of the three homesteads with grassland cover still present within the extent of the homestead parcel, one possessed a grassland bald that is far from the mapped position of the historic grassland, and two contained grasslands that are presently near the mapped historic grasslands though they are very small in extent and clearly show encroachment of woody vegetation.

Descriptions on two claims documented the effects of a severe disturbance on chaparral. A fire passed through these two neighboring claims three years prior to being surveyed. Both surveys reported that the chaparral on a portion of these parcels had been burned over and had since grown back to chaparral. Some interesting observations were made of land cleared by homesteaders. A portion of one parcel was recorded as "cleared, given a fair agricultural test,... now abandoned, and yellow pine encroaching from all sides"(MacKechnie 1916). Another historic account offers a testament to the persistence of oaks after clearing. "There is a great deal of scrub oak where they have cleared, which has necessitated much hard work to clear and grub"(Gribble 1912).

The influence of livestock grazing, burning by cattlemen, as well as clearing on these parcels by previous Euro-Americans inhabitants, offer alternative explanations for the existence of grasslands and open areas near drainages on the homestead parcels we examined. This is in addition to the notion that these grasslands were recently burned patches of non-forest vegetation, were edaphically controlled and maintained by fire, and/or that they owe their origin to Native American management.

Little evidence of open *Quercus* savannas was found within the homestead parcels. Vegetation may have increased in density and canopy cover prior to the Forest Reserve Homestead Act. LaLande (1995) indicates that Native American burning in the Applegate River watershed would have been concentrated at low elevations and certain high elevation sites. It is also possible that *Quercus* savanna vegetation structures were located beyond the lower to middle slope locations occupied by the homestead patent applications, were avoided by applicants, and/or were rare on low and middle elevation slopes in

the Applegate River watershed during the time of the Forest Reserve Homestead Act.

Conclusions

The unavailability of lowlands with alluvial soils favored against settlement in the broader valley bottom of the Applegate River watershed and the requirements for a successful patent application favored against settlement on lands with high timber volume. Instead, homesteaders during the time period of 1907–1918 selected lands with a high occurrence of non-conifer vegetation and stands of regenerating conifer forest. Homestead patent applications revealed that many sites showed signs of human disturbances from before the application process including mining, livestock grazing, and prior attempts at settlement.

Our results substantiated some of the presumed effects that modern fire suppression has had on this landscape. Grasslands mapped by Forest Service surveyors have been severely diminished over time. Nearly half of their historic extent is now occupied by Non-forest Vegetation consisting of mostly shrublands and hardwood woodlands, with much of the remainder converted to agricultural land. Furthermore, a shift from hardwood woodland to conifer domination occurred over a limited area.

The conversion of native vegetation to agricultural land had lasting effects on many homestead parcels, particularly the conversion of native grasslands to cultivated land. However, settlement was not always successful on this portion of the landscape. Just under half of the land area cleared historically had remained cleared; the rest had reverted to Non-forest Vegetation or Conifer Forest.

Conifer Forest has maintained much of its historic position and extent. Much of the area classed as Shrubland in historic maps remained classified as Non-forest Vegetation in WODIP. The predominant change was from historic Shrubland to Conifer Forest and historic Conifer Forest to Non-forest Vegetation. A recent study using General Land Office survey records to examine historic vegetation change of the Rogue River watershed, of which the Applegate River is a major tributary, revealed a similar pattern of change from one dominant vegetation type to another but with the transition balancing out such that the overall character of the vegetation across the landscape remained consistent over time (Duren et al. 2012).

The historic physiognomic structure of the vegetation of the area examined on low and middle elevation slopes in the Applegate River watershed was not predominantly "open" prior to modern era fire suppression efforts. Chaparral communities with a dense brushy character and closed canopy woodlands were common in areas subject to homestead patent applications and similar vegetation persists at many of these same locations at present. Many shrublands included scattered conifer trees historically. The primary sources investigated in this study did describe the vegetation of some areas as grassland and open woodland; however, the majority of the area surveyed was described as shrubland. In addition, historic conifer forests were often described as dense or having a brushy understory. The frequent occurrence of shrublands had not been well documented previously in studies of historic vegetation that included the Applegate River watershed (Hickman and Christy 2011; Duren et al. 2012).

Patent applications that were the subject of the historic surveys were heavily biased towards low and middle elevation slopes and higher up within some watersheds. Earlier historic accounts of open vegetation conditions (e.g., savannas and grasslands) were biased towards broad valley bottoms and travel corridors. Vegetation that was open and vegetation that was brushy coexisted in the historic landscape of the Applegate River watershed. These two structural types generally occurred on different geographic and topographic locations on this landscape, with the extents of each type augmented through space and time in response to broad gradients in environmental variables and natural and human caused disturbances. Reference conditions that include shrub dominated vegetation, closed canopy woodlands, and patches of conifer forest at low elevations align better with the late settlement era vegetation patterns of low and middle elevation slopes of the Applegate River watershed as described by our data and other studies (Hickman and Christy 2011; Duren et al. 2012).

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